The Influence of “Omental Cake” Presence on the Completeness of Cytoresduction in Advanced-stage Ovarian Cancer

NICOLAE BACALBASA^{1,2,3}, CAMELIA DIACONU^{1,4}, LAURA ILIESCU^{1,5}, CORNEL SAVU^{1,6},
OVIDIU GABRIEL BRATU^{1,7}, CIPRIAN BOLCA⁶, DRAGOS CRETOIU^{1,8}, ALEXANDRU FILIPESCU^{1,9},
SIMONA DIMA³, CRISTIAN BALALAU^{1,10} and IRINA BALESCU¹¹

¹“Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania;

²Department of Obstetrics and Gynecology, “I. Cantacuzino” Clinical Hospital, Bucharest, Romania;

³Department of Visceral Surgery, Center of Excellence in Translational Medicine
“Fundeni” Clinical Institute, Bucharest, Romania;

⁴Department of Internal Medicine, University Emergency Hospital Bucharest, Bucharest, Romania;

⁵Department of Internal Medicine, “Fundeni” Clinical Institute, Bucharest, Romania;

⁶Department of Thoracic Surgery, “Marius Nasta” Institute of Pneumonology, Bucharest, Romania;

⁷Department of Urology, Emergency Central Military Hospital,
Academy of Romanian Scientists, Bucharest, Romania;

⁸“Alessandrescu-Rusescu” National Institute of Mother and Child Health,
Fetal Medicine Excellence Research Center, Bucharest, Romania;

⁹Department of Obstetrics and Gynecology, “Elias” Emergency Hospital, Bucharest, Romania;

¹⁰Department of Surgery, “Pantelimon” Clinical Hospital, Bucharest, Romania;

¹¹Department of Surgery, “Ponderas” Academic Hospital, Bucharest, Romania

Abstract. *Background/Aim:* The presence of “omental cake” has been considered since long as a negative prognostic factor in patients diagnosed with advanced-stage ovarian cancer. The aim of this paper was to study the impact of “omental cake” presence on the perioperative outcomes in advanced-stage ovarian cancer. *Patients and Methods:* Between 2015 and 2020, 85 patients were submitted to surgery for advanced-stage ovarian cancer. *Results:* Among cases diagnosed with “omental cake” the rate of complete cytoresduction was significantly diminished when compared to cases in which this entity was not revealed. In the meantime, the presence of omental cake among cases in which complete debulking was achievable was significantly associated with a higher number of digestive resections when compared to the other cases submitted to surgery and in which tumoral transformation of the omentum was encountered. *Conclusion:* The presence of “omental cake” is associated with a higher

rate of incomplete resections. However, in cases in which complete debulking was achieved, the presence of omental cake was associated with a significantly higher number of digestive tract resections.

Ovarian cancer, also known as “the silent killer”, is recognized for late diagnostic due to the fact that up to 60% of cases remain asymptomatic for a long period of time (1, 2); it represents the second most common gynecological cancer affecting women worldwide. In this context, most cases are diagnosed at advanced stages of the disease when debulking surgery to no residual disease is hardly feasible. One of the commonest routes of spread of this malignancy is represented by the peritoneal route; in this context, a significant number of cases will present extended metastatic lesions at the level of the greater omentum (3, 4). The tumoral involvement of the greater omentum might vary from isolated nodules to confluent tumoral areas which will transform these viscera into a veritable tumor that, in certain cases, might invade the adjacent viscera. This finding has been commonly named as “omental cake” and might be associated with tumoral invasion of the colonic segments, of the greater gastric curvature, of the small bowel and even of the hepatic or splenic structures. In such cases multiple visceral resections might be needed in order to achieve complete cytoresduction (5-9). The aim of the current paper

This article is freely accessible online.

Correspondence to: Irina Balescu, “Ponderas” Academic Hospital, Nicolae Caramfil 85a Street, Bucharest 014142, Romania. Tel: +40 724077709, e-mail: irina.balescu@ponderas-ah.ro

Key Words: Omental cake, debulking, ovarian cancer.

Figure 1. Omental cake – lesion invading the transverse colon.

was to analyze the perioperative outcomes of patients presenting “omental cake” transformation and compare them to those encountered in patients presenting less extended omental involvement.

Patients and Methods

After obtaining the approval of the Ethical Committee no 45/March 2020, data of patients submitted to surgery for advanced-stage ovarian cancer were retrospectively reviewed. Patients were classified according to the 2014 FIGO system (10), while postoperative complications were classified according to Dindo-Clavien scale (11). Cytoreductive surgery was classified as complete cytoreduction if no residual disease was encountered at the end of the surgical procedure, optimal cytoreduction if the residual disease was smaller than 5 mm and suboptimal debulking if the residual disease was larger.

Results

Between 2015 and 2020, 85 consecutive patients were submitted to surgery with curative intent. The median age at the time of surgery was 48 years (range=24-83 years). Preoperatively all but four patients were classified as FIGO stage IIIC ovarian cancer while the median value of CA125 levels was 4,330 U/ml (range=550-8,990 U/ml). All cases were submitted to computed tomography (CT) in order to assess the extension of the lesions; among the 85 patients, omental cake was suspected in 35 cases. However, due to the fact that there were no criteria suggesting the presence of unresectable disease, all cases were submitted to surgery as

Figure 2. Specimen of transverse colectomy en-bloc with total omentectomy for omental cake invading the transverse colectomy.

the first intention treatment. Intraoperatively, in four of the 35 cases multiple digestive loops were invaded by the tumoral omentum, therefore the intervention was limited to a biopsy and patients were further confined to the oncology department. In the other 31 cases debulking surgery with curative intent was tempted. In Figure 1 we present an example of a lesion invading the transverse colon. Among these cases cytoreduction was considered as complete in 1 of 11 cases, as optimal in 1 of 9 cases and as suboptimal in the remaining 11 cases. Furthermore, among cases in which complete debulking was achieved the most commonly encountered associated visceral resections were represented by total omentectomy in two cases, total omentectomy *en bloc* with transverse colectomy in six cases, total omentectomy in association with subtotal colectomy in three cases and respectively total omentectomy in association with total colectomy in one case (Figure 2). Moreover, three of the 11 cases also necessitated association of small bowel resections while in one case partial gastrectomy was also needed. Postoperatively two cases developed digestive leaks and necessitated re-operation. Intraoperative and postoperative details are presented in Table I.

These data were compared to those reported in the remaining 50 cases in which there were no preoperative data suggesting the presence of omental cake. Among these cases intraoperatively diagnosis of omental cake was encountered in two cases; however, both cases benefited from complete cytoreduction. In one case total omentectomy was necessary while in the second case total omentectomy *en bloc* with transverse colectomy and small bowel resection were needed in order to achieve complete debulking. Fortunately, both cases reported a favorable oncological outcome, none of the patients experienced postoperative complications. In the remaining 48 cases the preoperative image findings were

Table I. Perioperative findings among patients diagnosed with omental cake.

Perioperative parameter	No. of cases
Median age at diagnostic	51 years (range=35-68 years)
Median value of CA125 levels	6,750 U/ml (range=2,380-8,990 U/ml)
Median volume of ascites	3,500 ml (range=2,000-5,000 ml)
Type of cytoreduction	
Complete cytoreduction	11 (35.4%)
Optimal cytoreduction	9 (25.7%)
Suboptimal cytoreduction	11(35.4%)
Biopsy	4 (11.4%)
Estimated blood loss (ml)	750 ml (range=300-1,200 ml)
Length of surgery (minutes)	220 min (range=60-330 min)
Postoperative complications	
Dindo-Clavien 2 (fever of unknown origin)	2 (5.7%)
Dindo-Clavien 3 (abdominal collection which benefited from percutaneous drainage)	1 (2.8%)
Dindo-Clavien 4 (reintervention)	2 (5.7%)

similar to the intraoperative findings. Debulking surgery with curative intent was attempted in all cases; however, complete cytoreduction was achieved in 34 cases, optimal cytoreduction was performed in 11 cases while in the remaining three cases the cytoreduction was suboptimal. The reasons for suboptimal cytoreduction were represented by tumoral masses invading the liver pedicle in one case and respectively the presence of disseminated nodules at the level of the small bowel mesentery in two cases. As for the necessity of association of digestive resections, they consisted of rectosigmoidian resections in 10 cases, right colectomy in three cases, subtotal colectomy in two cases and small bowel resections in four cases. Postoperatively three patients necessitated reintervention and were caused by postoperative bleeding in two cases and respectively a colorectal leak in one case. Intraoperative and postoperative details are presented in Table II.

As can be observed from the data below, the median age between the two groups were comparable (46 years *versus* 51 years, $p=0.763$). As for the level of serum CA125 and volume of ascites, these two parameters were reported to be significantly higher in cases diagnosed with omental cake (6,750 U/ml *versus* 3,480 U/ml for CA125 levels, $p=0.004$ and respectively 3,500 ml *versus* 1,500 ml for the volume of ascites, $p=0.01$). When comparing the intraoperative results among the two groups, statistically significant differences were encountered between the proportion of patients who benefitted from complete debulking surgery (70.8% among patients with no omental cake *versus* 35.4% among cases with omental cake, $p=0.003$) as well as between the number

Table II. Intraoperative and postoperative findings among patients with no intraoperative signs of omental cake.

Perioperative parameter	No. of cases
Median age at diagnostic	46 years (range=24-83 years)
Median value of CA125 levels	3,480 U/ml (range=550-5,430 U/ml)
Median volume of ascites	1500 ml (range=500-3,300 ml)
Type of cytoreduction	
Complete cytoreduction	34 (70.8%)
Optimal cytoreduction	11 (22.9%)
Suboptimal cytoreduction	3 (6.2%)
Estimated blood loss (ml)	680 ml (range=320-1,400 ml)
Length of surgery (minutes)	250 min (range=140-380 min)
Postoperative complications	
Dindo-Clavien 2 (fever of unknown origin)	4 (8.3%)
Dindo-Clavien 3 (abdominal collection which benefited from percutaneous drainage)	1 (2%)
Dindo-Clavien 4 (reintervention)	3 (6.2%)

of cases necessitating visceral resections (100% in cases presenting omental cake *versus* 39.5%, $p=0.001$). However, no significant difference was observed between the two groups in terms of estimated blood loss (750 ml *versus* 680 ml, $p=0.723$), length of surgery (220 minutes *versus* 250 min, $p=0.522$) or postoperative complications requiring reintervention (5.7% *versus* 6.2%, $p=0.127$).

Discussion

Initially considered as a fatty apron which covers the small bowel by Hippocrates and Aristotle, the role of the omentum was studied for the first time in 1893 by Ross, who demonstrated its protective function for the abdominal organs (12-14). Two decades later, the role of omentum in limiting the inflammatory processes was intuited when studying the modifications which take place at this level in cases presenting acute abdominal pathologies such as gastric ulcer, appendicitis or bowel obstruction (15).

Defined as a multi-layer structure with peritoneal origin which extends from the stomach and transverse colon and which covers the small bowel, the greater omentum contains various amounts of lymph nodes as well as fatty tissue (16). This structure plays a crucial role in preventing the development of different pathological processes at the abdominal level; however, at a certain point this structure will be transformed from a natural barrier to a pattern of spread for malignant cells with various origins, leading to development of a tumoral mass. This transformation is frequently encountered in malignancies such as gastric, colonic or ovarian cancer and has been considered since long as a sign of poor outcomes (17, 18). When it comes to ovarian cancer, two

essential observations regarding the role of omentum should be presented; the first is referred to the fact that cases in which omentum was retrieved at the time of primary surgery exhibited a better outcome and the second is referred to the fact that in cases in which ovarian cancer relapsed, the greater omentum was a frequently encountered site of relapse (19-21). In this respect, omentectomy has been routinely associated as part of debulking surgery for advanced-stage ovarian cancer (19); therefore, since 2012, infracolic omentectomy became part of the guidelines for treating ovarian cancer (22).

However, in certain cases tumor invasion of the omentum might be massive, leading to transformation of the greater omentum in a diffuse thickened, tumoral mass; in such cases the unanimously accepted notion is of omental cake and might be associated with poorer outcomes. Most often, the presence of omental cake is associated with extensive disease which might preclude the achievement of a complete cytoreduction.

An interesting study that investigated the influence of the presence of omental cake on the type of cytoreduction was conducted by Fagotti *et al.* in 2006 (23). The study included 61 patients diagnosed with advanced-stage ovarian cancer, submitted to laparoscopy in order to evaluate the feasibility of complete cytoreduction. The authors created a score which included the presence of omental cake, peritoneal carcinomatosis, diaphragmatic carcinomatosis, mesenteric, bowel, gastric infiltration and respectively the presence of liver metastases, each criteria being noted with an index of 2; this index was calculated during laparoscopy and therefore patients were submitted to debulking surgery. The rate of patients benefitting from optimal debulking (defined by the presence of residual volume smaller than 1 cm) was of 67.2% and was significantly influenced by the laparoscopic-based score; therefore, the chances of achieving optimal cytoreduction were significantly diminished in cases in which this score was higher than 8, the specificity and the positive predictive value of the method being of 100% (23). In this respect, the affirmation that the presence of omental cake significantly influences the risk of achieving an incomplete debulking proves to be a valid one. A more recent study conducted on this issue involved 279 patients submitted to cytoreductive surgery with curative intent; among these cases incomplete cytoreduction was significantly influenced by the presence of omental cake and diffuse peritoneal thickening (24). Similarly to these studies, in our case the presence of omental cake significantly diminished the chances to achieve complete debulking.

In order to achieve a better identification of patients who might present omental cake and might not benefit from complete cytoreduction, more recent studies came to propose new predictive scores based on preoperative investigations (25). Therefore, it seems that information given by computed tomography might play a crucial role. According to Kim's study, the presence of omental involvement extending to the

stomach or spleen on the preoperative computed tomography in association with inguinal or pelvic lymph node involvement should be considered as predictive factors for suboptimal debulking; in this context the authors underlined the utility of administration of neoadjuvant therapy in such cases in order to increase the radicality of the surgical procedure. However, association of omental cake, large volumes of ascites and higher levels of CA125 were not significantly correlated with incomplete debulking. Moreover, the authors underlined the fact that the findings reported at computed tomography were closely correlated with those encountered intraoperatively (25).

As for the necessity of performing multiple visceral resections in such cases, this finding seems to be perfectly justified due to the close anatomical reports between the greater omentum and the digestive tract represented by transverse colon, greater gastric curvature and small bowel; furthermore, extension of the nodules of peritoneal carcinomatosis at the level of the other segments of the colon as well as the development of visceral peritoneal carcinomatosis explains why more extended digestive resections such as subtotal or even total colectomy might be needed in order to achieve complete cytoreduction (3-5, 19).

Conclusion

Omental cake is a common finding among patients with advanced-stage ovarian cancer that might significantly influence the outcomes of these patients. First of all, this pathological finding seems to be responsible for the impossibility of achieving complete cytoreductive surgery in an important number of cases; second of all, this pathological entity might impose performing multiple visceral resections in cases in where radical surgery is feasible. In order to minimize the risk of incomplete debulking, different predictive scores have been proposed, most of them having among the inclusion criteria the preoperative aspect suggesting the presence of omental cake. In conclusion, whenever omental cake is suspected, a tailored therapeutic strategy should be taken in consideration in order to maximize the efficacy of the oncological treatment.

Conflicts of Interest

The Authors declare that there are no conflicts of interest regarding this study.

Authors' Contributions

NB: Performed the surgical procedures; IB: prepared the manuscript; CD, LI, CB, DC, SD: performed data analysis; OGB, AF, CB, CS: were part of the surgical team; DC: advised about the oncological outcome; NB, CB: revised the final draft of the manuscript.

Acknowledgements

This work was supported by the project entitled "Multidisciplinary Consortium for Supporting the Research Skills in Diagnosing, Treating and Identifying Predictive Factors of Malignant Gynecologic Disorders", project number PN-III-P1-1.2-PCCDI2017-0833.

References

- 1 Ferlay J, Steliarova-Foucher E, Lortet-Tieulent J, Rosso S, Coebergh JW, Comber H, Forman D and Bray F: Cancer incidence and mortality patterns in Europe: estimates for 40 countries in 2012. *Eur J Cancer* 49(6): 1374-1403, 2013. PMID: 23485231. DOI: 10.1016/j.ejca.2012.12.027
- 2 Pecorelli S, Favalli G, Zigliani L and Odicino F: Cancer in women. *Int J Gynaecol Obstet* 82(3): 369-379, 2003. PMID: 14499983. DOI: 10.1016/s0020-7292(03)00225-x
- 3 Bristow RE, Tomacruz RS, Armstrong DK, Trimble EL and Montz FJ: Survival effect of maximal cytoreductive surgery for advanced ovarian carcinoma during the platinum era: a meta-analysis. *J Clin Oncol* 20(5): 1248-1259, 2002. PMID: 11870167. DOI: 10.1200/JCO.2002.20.5.1248
- 4 Aletti GD, Dowdy SC, Gostout BS, Jones MB, Stanhope CR, Wilson TO, Podratz KC and Cliby WA: Aggressive surgical effort and improved survival in advanced-stage ovarian cancer. *Obstet Gynecol* 107(1): 77-85, 2006. PMID: 16394043. DOI: 10.1097/01.AOG.0000192407.04428.bb
- 5 Bacalbasa N, Balescu I, Dima S, Herlea V, David L, Brasoveanu V and Popescu I: Initial incomplete surgery modifies prognosis in advanced ovarian cancer regardless of subsequent management. *Anticancer Res* 35(4): 2315-2320, 2015. PMID: 25862895.
- 6 Bacalbasa N, Balescu I, Dima S, Brasoveanu V and Popescu I: Hematogenous splenic metastases as an independent negative prognosis factor at the moment of primary cytoreduction in advanced stage epithelial ovarian cancer-a single center experience. *Anticancer Res* 35(10): 5649-5654, 2015. PMID: 26408738.
- 7 Bacalbasa N, Balescu I, Dima S, Brasoveanu V and Popescu I: Splenectomy as part of cytoreductive surgery in recurrent epithelial ovarian cancer. *Anticancer Res* 35(9): 5097-5101, 2015. PMID: 26254413.
- 8 Bacalbasa N, Balescu I and Dima S: Rectosigmoidian involvement in advanced-stage ovarian cancer - intraoperative decisions. *In Vivo* 31(5): 973-977, 2017. PMID: 28882968. DOI: 10.21873/in vivo.11156
- 9 Bacalbasa N, Balescu I and Filipescu A: Debulking surgery for clear cell carcinoma of the ovary - a case report and literature review. *Anticancer Res* 37(10): 5707-5711, 2017. PMID: 28982890. DOI: 10.21873/anticancer.12008
- 10 FIGO Ovarian Cancer Staging. Effective Jan. 1, 2014. Available at: https://www.sgo.org/wp-content/uploads/2012/09/FIGO-Ovarian-Cancer-Staging_1.10.14.pdf
- 11 Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, de Santibanes E, Pekolj J, Slankamenac K, Bassi C, Graf R, Vonlanthen R, Padbury R, Cameron JL and Makuuchi M: The Dindo - Clavien classification of surgical complications: five-year experience. *Ann Surg* 250(2): 187-196, 2009. PMID: 19638912. DOI: 10.1097/SLA.0b013e3181b13ca2
- 12 Platell C, Cooper D, Papadimitriou JM and Hall JC: The omentum. *World J Gastroenterol* 6(2): 169-176, 2000. PMID: 11819552. DOI: 10.3748/wjg.v6.i2.169
- 13 Walker FC: The protective function of the greater omentum. *Ann R Coll Surg Engl* 33: 282-306, 1963. PMID: 14075041.
- 14 O'Malley CD, Saunders JB and Saunders CM: Leonardo da Vinci on the human body. The anatomical, physiological, and embryological drawings of Leonardo da Vinci. New York: H. Schuman, pp. 506, 1952.
- 15 Konturek SJ, Brzozowski T, Majka I, Pawlik W and Stachura J: Omentum and basic fibroblast growth factor in healing of chronic gastric ulcerations in rats. *Dig Dis Sci* 39(5): 1064-1071, 1994. PMID: 7513630. DOI: 10.1007/bf02087559
- 16 Han Q, Ganesh H and DiSantis DJ: Omental cake. *Abdom Radiol (NY)* 41(10): 2080-2081, 2016. PMID: 27259336. DOI: 10.1007/s00261-016-0795-7
- 17 Levitt RG, Sagel SS and Stanley RJ: Detection of neoplastic involvement of the mesentery and omentum by computed tomography. *AJR Am J Roentgenol* 131(5): 835-838, 1978. PMID: 101039. DOI: 10.2214/ajr.131.5.835
- 18 Hamrick-Turner JE, Chiechi MV, Abbitt PL and Ros PR: Neoplastic and inflammatory processes of the peritoneum, omentum, and mesentery: diagnosis with CT. *Radiographics* 12(6): 1051-1068, 1992. PMID: 1439011. DOI: 10.1148/radiographics.12.6.1439011
- 19 Ben Arie A, McNally L, Kapp DS and Teng NN: The omentum and omentectomy in epithelial ovarian cancer: a reappraisal. Part I-Omental function and history of omentectomy. *Gynecol Oncol* 131(3): 780-783, 2013. PMID: 24056004. DOI: 10.1016/j.ygyno.2013.09.014
- 20 Pemberton FA: Carcinoma of the ovary. *Am J Obst C Gynec* 40: 751-760: disc. 760-763, 1940.
- 21 Bergman F: Carcinoma of the ovary. A clinicopathological study of 86 autopsied cases with special reference to mode of spread. *Acta Obstet Gynecol Scand* 45(2): 211-231, 1966. PMID: 4287500. DOI: 10.3109/00016346609158447
- 22 Berek JS, Crum C and Friedlander M: Cancer of the ovary, fallopian tube, and peritoneum. *Int J Gynaecol Obstet* 119 Suppl 2: S118-S129, 2012. PMID: 22999503. DOI: 10.1016/S0020-7292(12)60025-3
- 23 Fagotti A, Ferrandina G, Fanfani F, Ercoli A, Lorusso D, Rossi M and Scambia G: A laparoscopy-based score to predict surgical outcome in patients with advanced ovarian carcinoma: a pilot study. *Ann Surg Oncol* 13(8): 1156-1161, 2006. PMID: 16791447. DOI: 10.1245/ASO.2006.08.021
- 24 Janco JM, Glaser G, Kim B, McGree ME, Weaver AL, Cliby WA, Dowdy SC and Bakkum-Gamez JN: Development of a prediction model for residual disease in newly diagnosed advanced ovarian cancer. *Gynecol Oncol* 138(1): 70-77, 2015. PMID: 25913130. DOI: 10.1016/j.ygyno.2015.04.013
- 25 Kim HJ, Choi CH, Lee YY, Kim TJ, Lee JW, Bae DS and Kim BG: Surgical outcome prediction in patients with advanced ovarian cancer using computed tomography scans and intraoperative findings. *Taiwan J Obstet Gynecol* 53(3): 343-347, 2014. PMID: 25286788. DOI: 10.1016/j.tjog.2013.10.041

Received March 31, 2020

Revised April 8, 2020

Accepted April 21, 2020